A MOBILE FIRE WEATHER FORECAST UNIT

634.9.43 (794)

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Since July, 1926, an intensive fire weather service has been in operation in California. The principal object of this service is an economic one—to aid all fire prevention and suppression agencies in their efforts to reduce losses from forest, grass, grain, and brush fires. That the fire problem in California is economically of great importance is shown by the fact that outdoor fires in 1928 in this State alone caused losses totaling nearly four and one-half million dollars.

The fire weather service of the Weather Bureau was established at the earnest request of fire agencies, which were much impressed with the importance of weather conditions in their effects on fires. The fire weather service works in close cooperation with these agencies, Federal, State, and private.

The term "fire weather" aptly describes those combinations of weather conditions which cause fires or which favor their rapid spread when once started. Lightning, for example, causes from 10 to 45 per cent of all outdoor fires in California, depending on the character of the individual season. Dry and windy weather causes rapid spread and difficult control of fires, however they may have been started.

Severe lightning concentrations in California have caused more than 350 lightning fires on national forests during a single thunderstorm period of two and one-half days. Thunderstorms of the relatively "dry" type thus constitute the fire-causing phase of fire weather.

Hot, dry, windy weather constitutes the fire-spreading phase of fire weather. Atmospheric relative humidity, as it affects the dryness of fuels through its control of the rate of evaporation of fuel moisture into the air, and wind direction and velocity, as the latter influences the evaporation rate, and as both together determine the direction and rate of spread of fires, are generally considered to be approximately of equal importance under California conditions in the production of dangerous fire weather.

Low relative humidity causes drying of forest fuels to a state approaching tinder. Fires once started in such fuel by human carelessness or lightning, spread rapidly when fed with additional oxygen and fanned by the wind. The wind frequently spreads sparks far in advance of the main fire. These sparks cause "spot" fires, which may and often do exceed the parent fire in size and difficulty of control. Rough field determinations have indicated that the rate of spread of fire in grass and low brush varies directly as the square of the wind velocity up to velocities of about 15 miles per hour; at higher velocities the increase in rate of spread is not proportionately so great.

It will be apparent from what has just been said that fire-weather factors are of vital importance in connection with fire prevention and suppression work; that they are practically evident and not mere theoretical abstractions.

The service rendered to fire prevention and suppression agencies by the Weather Bureau is primarily a forecast service. Systematic fire-weather forecasts are issued by the district forecaster of the weather bureau at San Francisco, based on the usual synoptic weather reports and charts, supplemented by daily telegraphic reports from specially established fire-weather observing stations on forest areas.

While the general fire-weather forecasts thus issued are very helpful to fire agencies in planning general fire action the forecasts are not and can not, under the circumstances, be sufficiently specific and adapted to local fire conditions to warrant their use as bases for detailed tactics to be used in suppressing a given fire. The district forecaster has no knowledge of the local topography and cover conditions. Foresters believe that forecasts of the specific type in connection with fire tactics offer the greatest opportunity for economic saving.

In an effort to supply the type of forecasts desired on large going fires, a 26,000-acre fire on the Santa Barbara National Forest was visited during the 1928 fire season and experimental forecasts were issued by a meteorologist on the ground. He was advised daily by wire from San Francisco regarding the general weather situation, and this information was supplemented by detailed observations taken at key points in the vicinity of the fire. This experiment was successful, the forest supervisor commenting that the forecasts furnished were directly helpful in planning the right tactics which led to final control of the fire, and that a considerable saving in suppression costs undoubtedly resulted directly from these forecasts.

Since fires and their complex topographical surroundings can not be taken to the district forecast center for analysis, a mobile weather bureau office has been planned to take equipment and a meteorologist to the fires.

The plan will be put into effect July 1, 1929. A ton-and-a-half truck is being equipped with meteorological instruments for use on the fire area, including anemometers, hydrothermographs, psychrometers, maximum and minimum thermometers, rain gage, and instrument shelters, as well as a barograph and aneroid barometer of smaller size; with radio receivers covering the short wave, long wave, and broadcast bands to copy the twice daily detailed weather broadcasts, including general forecasts, from naval radio station NPG at Mare Island; with charting facilities to prepare synoptic charts similar to those prepared at San Francisco; and with accommodations for the personnel of two men who will operate the unit, a meteorologist in charge, and a combination observer and radio operator.

The unit will travel throughout the entire State during the fire season, being dispatched to going fires by telegraphic orders from a central dispatching agency in the office of the Forest Service at San Francisco. The unit will maintain telegraphic communication with San Francisco and keep the dispatching agency notified of the whereabouts of the unit, actual and prospective. When not engaged on special forecasting work on going fires, the usual fire weather field work, chiefly the establishment of fire weather observing stations on forest areas for survey purposes, will be carried on.

Upon receipt of orders, the unit will proceed immediately to a large going fire, set up radio apparatus, establish temporary check or key weather stations in the fire vicinity, and issue detailed forecasts of weather, wind, temperature, relative humidity, and other factors influencing the choice of fire tactics and the ultimate control of the fire. Forecasts will be of the short period type, issued twice daily, together with such special advices as may be required in connection with backfiring and similar operations.

After the close of the fire season in northern California, it is planned to station the unit at a "fire house"

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or permanent base in southern California to give service on late fall fires common in that part of the State.

The unit will be operated for an experimental period of two fire seasons, the mobile equipment being supplied by the United States Forest Service, the operating expenses being paid by the California State Division of Forestry and the operating personnel and radio and meteorological equipment being supplied by the United States Weather Bureau.

If this novel plan is successful, and no insurmountable obstacles are now apparent, it is probable that three such units will be operated in California, one each in the northern, central, and southern parts of the State. The applicability of this plan to other forested areas in the far West is evident, since the weather data as broadcast from station NPG, on the reception of which the plan depends for success, can be copied almost anywhere west of the Mississippi. The fire agencies of British Columbia are much interested in the working out of this plan, and if successful in this State, consider it desirable to adopt it for their region, equipping launches instead of automobile trucks.

This plan will be on trial during the next two fire seasons in California. Past experience with this system on large going fires shows the plan to have much promise. We have reason to believe that successful operation of the system will be of far-reaching importance and application to organized fire protection work.

THE RECORD OF EVAPORATION STATIONS IN CALIFORNIA

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By ERNEST E. EKLUND

[Weather Bureau Office, San Francisco, Calif., June 21, 1929]

Of the various climatic factors that have always an important, and sometimes predominant, influence on the economic development of a nation, state, county, or city, evaporation is one of more than academic interest throughout the semiarid Southwest, and particularly in California. Here the development of intensive farming and of hydroelectric power is dependent upon an average seasonal precipitation of approximately 25 inches, occurring during a few winter months. The snow pack that accumulates in the higher mountains during the winter is equivalent to an immense reservoir that keeps many streams flowing through all or part of the practically rainless summer, and in addition many huge reservoirs have been constructed to supply water for civic uses, for operating hydroelectric power plants and for irrigating many thousands of acres of farming land. A large portion of the water impounded, and of that distributed over the land in irrigation, is lost by evaporation. For this reason the question of evaporation becomes of considerable importance in the economic development of California.

The first evaporation measurements made in California, of which we have a record, were begun in 1881 at Kingsburg by the State department of engineering, but the first measurements of evaporation undertaken by the Weather Bureau were those made 20 years ago at Salton Sea and at auxiliary stations. It was not until 1918 that stations were established on a permanent basis with the standard class A equipment, now in use. At that time, records were being made at Lake Tahoe, using a floating pan, but in 1918 three stations were established, using land pans according to the present Weather Bureau standard. Two of these stations have been in operation ever since; one was closed of necessity in 1923. In 1924 and in 1925, two additional stations were established, making five stations cooperating with the Weather Bureau at the present time.

More than the usual number of requests for evaporation data were recently received at the San Francisco Weather Bureau Office and, as it was known that some evaporation records had been made or were being made in California without the cooperation of the Weather Bureau, efforts were made to learn what additional records might be available. A card was mailed to all California addresses that received Climatological Data—California Section. The card read: "The Weather Bureau is desirous of obtaining information relative to evaporation measurements in California that have been made, or are now being made, without the cooperation of the Weather Bureau. If you know of any such evaporation records, kindly give the information requested in the blank spaces below, and mail this card which requires no postage." The blank spaces were for the names and addresses of the persons making and reporting the observations. The response was immediate and gratifying. Many of the returned cards related to evaporation records, but the majority offered the use of other kinds of records or reported "no records known." The cards were followed up by circular letters and questionnaires addressed to the persons who were reported as having made evaporation measurements.

From the information thus obtained, a table has been compiled, the stations being arranged approximately in geographical order from north to south. In the table are included a few stations that are beyond the borders of the State but which may be considered as having the same climatic characteristics as the adjacent portions of California. The table is known to be incomplete but contains some information about most of the evaporation records that have been made in California. Unless otherwise stated, the evaporation was measured from fresh water. No attempt has been made to collect the actual records, for to assemble them in a manner that would render them useful would be practically impossible. Any attempt to correlate all of them would be hopeless, due to the great dissimilarity of equipment and methods and, in some cases, to the lack of specific information as to the conditions under which the measurements were made. A map is also presented (not reproduced), on which the stations are numbered as in the table, but all records made in any given locality are listed under one number. It is interesting to note on the map that the stations are most numerous in those sections of California where irrigation and power projects have reached their highest development; also that they are numerous in the extreme southern portion where precipitation is comparatively light, and totally lacking in northwestern California where precipitation is heaviest.

Why have so many evaporation measurements been made in California? The factors determining evaporation from free water surfaces are generally agreed upon by physicists, meteorologists, and engineers but, despite the fact that the laws of evaporation have been investigated for centuries, a satisfactory method for computing the evaporation from a water surface already existing, or from such a surface to be created by constructing a reservoir, has been hard to find, and opinions still differ as to the proper method of measuring evaporation from a free water surface. Great variations in temperature, relative